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AD

RDT E PROJECT NO. 1X141806D133.06  
USAAVSCOM PROJECT NO. 67-29  
USAASTA PROJECT NO. 67-29

**ENGINEERING FLIGHT TEST OF THE  
PRODUCTION OH-6A HELICOPTER  
WITH FAIRINGS REMOVED**

**FINAL REPORT**

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**JULY 1969**

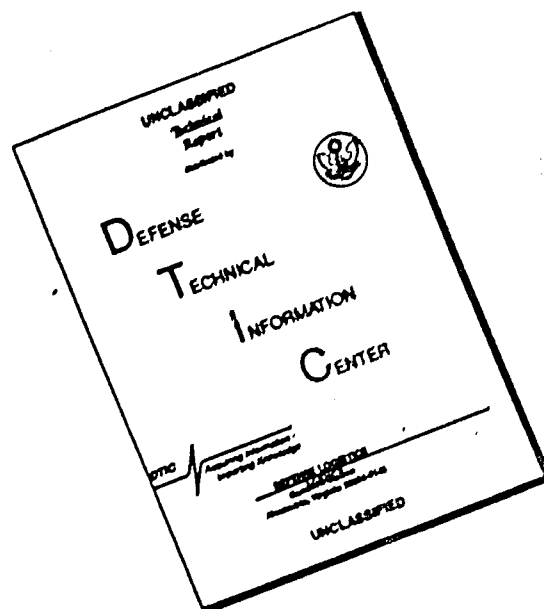
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USAASTA ~~XXXXXXXXXX~~ 67-29

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(18) FINAL REPORT. 27 JUL 69

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(11) JUL 1969

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US ARMY AVIATION SYSTEMS TEST ACTIVITY  
EDWARDS AIR FORCE BASE, CALIFORNIA 93523

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## **ABSTRACT**

Flight tests were conducted to determine the effects on performance and flying qualities of the OH-6A helicopter with various fairings removed. The fairings removed were the lower anticollision light cover, the main rotor blade root end fairings, the main rotor center hub fairing and the landing gear strut fairings. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing did not significantly affect the performance of the helicopter; however, removing the landing gear strut fairings resulted in a definite decrease in performance. The performance in the all fairings removed configuration was also significantly decreased. Stability and control tests were conducted in the all fairings removed configuration. Slight changes in control positions were evident but no major effects on flying qualities were observed. From a performance and flying qualities standpoint, it is feasible to operate the helicopter with these fairings removed. Although the performance changes are relatively small, allowances should be made in mission planning for all fairings removed and skid strut fairings removed configurations. If normal operations are to be conducted in these configurations, the data contained in this report should be included in TM 55-1520-214-10.

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# INTRODUCTION

## BACKGROUND

1. The detail specification for the production contract awarded to the contractor in May 1965 for the OH-6A helicopter incorporated significant changes to the airframe and engine of the prototype OH-6A tested by the US Army Aviation Systems Test Activity (USA-ASTA).
2. Differences between the prototype and production OH-6A helicopter were extensive enough to require a complete performance and stability and control test program which was conducted in 1967. A directive was received from the US Army Aviation Systems Command (USAAVSCOM) in December 1967 which required that a test be conducted to evaluate the OH-6A helicopter with various fairings removed (ref 1, app I).

## TEST OBJECTIVES

3. Objectives of these tests were to determine the effects on performance and handling qualities of operating the OH-6A with fairings removed individually and collectively.

## DESCRIPTION

4. The OH-6A helicopter, built by the Aircraft Division of Hughes Tool Co., has a single, four-bladed, fully articulated main rotor and a two-bladed, teetering, antitorque tail rotor. The cockpit configuration is a two place (pilot and observer/gunner), and the cargo area has provisions for two collapsible canvas passenger seats. Cyclic, collective and antitorque rotor pedal controls are conventional and unboosted. Skid-type landing gear with air-oil dampened shock struts is installed. The helicopter is powered by a T63-A-5A free turbine, turboshaft engine, derated to 260 shaft horsepower (shp) for takeoff and 221 shp for continuous operation.
5. Fairings removed were those covering the lower anticollision light, the landing gear struts, the main rotor blade root ends and the center of the main rotor hub. The removed fairings are shown in photographs 1 through 4, appendix VII. A detailed description of the OH-6A is contained in TM 55-1520-214-10 (ref 2, app I). Further information can be obtained from the manufacturer's Detail Specification HTC-AD-369-Y-8011 (ref 3).



## SCOPE OF TEST

6. Twenty productive test flights were performed in the vicinity of Edwards Air Force Base, California, to evaluate performance characteristics and handling qualities. Twelve level flight performance tests were conducted at a 2400-pound gross weight (grwt), 5,000- and 10,000-foot density altitudes ( $H_D$ ), a mid center of gravity (cg) location (100.0 in.) and a 483 rpm rotor speed. The tests were conducted in the following configurations: standard aircraft (clean configuration), lower anticollision light fairing removed, main rotor blade root fairings removed, main rotor center hub fairing removed, landing gear strut fairings removed and all fairings removed. Eight flights were made to evaluate stability and control characteristics with all fairings removed and in the standard configuration for comparison purposes.

## METHOD OF TEST

7. Since this test was performed to determine effects of configuration changes, the method used was to conduct the required tests in the desired configurations and to compare the results directly with data available for the standard configuration. Where appropriate, data obtained during the OH-6A Phase D test were used. In the case of qualitative comparisons of handling qualities, specific tests were conducted by the same pilot in both the standard configuration and in the desired test configuration.

8. Data were recorded both manually from sensitive cockpit instrumentation and on a photopanel. In addition, an oscillograph was used to record stability and control parameters. Fuel flow data specified in Engine Model Specification No. 580-F (ref 4, app I) were used to derive the specific ranges.

9. Dynamic stability and controllability characteristics were evaluated qualitatively; however, quantitative data were recorded.

10. A detailed description of the test methods is presented in appendix III, and a complete list of the test instrumentation is presented in appendix IV.

## CHRONOLOGY

11. The chronology of the tests is as follows:

Test Directive received	27 December 1967
Test aircraft received	16 February 1968
Test started	21 March 1968
Flight tests completed	16 May 1968
Draft report submitted	10 March 1969

# RESULTS & DISCUSSION

## GENERAL

12. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing had a negligible effect on the performance of the helicopter. Removal of the landing gear strut fairings resulted in a significant decrease in performance as did the removal of all fairings collectively. Slight changes in control positions were evident, but no major effect on flying qualities was observed with the fairings removed. Based on the results of this test it is feasible to operate the OH-6A helicopter with these fairings removed.

## PERFORMANCE

### Airspeed

13. An airspeed calibration, which was performed on the test aircraft by USAASTA in November, 1967, was used during this test (fig. 1, app II). The position error varies linearly from +3 knots at low speeds to +4 knots at high speeds.

### Level Flight

14. Level flights were conducted according to the test conditions in paragraph 6. The results of these flights are presented in figures 2 through 13, appendix II, and are summarized in table 1.

15. The clean-aircraft performance curves superimposed on figures 4 through 13, appendix II, were adjusted to allow comparison with the specific fairing configuration at the same thrust coefficient ( $C_T$ ). This adjustment was derived from data contained in the OH-6A Phase D Final Report (ref 5, app I).

16. The curves through the data points were based on the differences in equivalent flat plate areas. These differences were originally determined for the different configurations from a trial fit through the data points and were then averaged between their two values at the different density altitudes.

17. Although airspeeds in all configurations are limited by never exceed airspeed ( $V_{NE}$ ), there is a difference in the maximum airspeed based on power available and power required. Removing all fairings resulted in a 12-knot (9.6 percent) decrease in the maximum

TABLE 1. PERFORMANCE CHANGES FROM THE STANDARD CONFIGURATION.

Air Gross Weight 240,000 lb  
 Cruise Speed 485 kts  
 CL Location 100 ft

Density Altitude (ft):	Thrust Coefficient <sup>1</sup> (C <sub>T</sub> )	Increase in Elev. Flat Area	Test Type	Recommended Cruise Speed	Power for Recommended Fuel	Range <sup>2</sup>	95% Maximum Specific Range
	(5000) (10,000)	N/A	(4000) (10,000)	(100) (10,000)	(100) (10,000)	(100) (10,000)	(5,000) (10,000)
CONFIGURATION							
All Fairings Removed	.004865 .005648	2.3%				274	1,752
Standard	.004865 .005648	N/A				274	1,800
Skid Strut Fairings Removed	.004858 .005640	1.7%				274	1,742
Standard	.004858 .005640	N/A				274	1,800
Blade Root Fairings Removed	.004871 .005649	0.2%				274	1,792
Standard	.004871 .005649	N/A				274	1,800
Center Hub Fairing Removed	.004839 .005658	0.20				274	1,780
Standard	.004839 .005658	N/A				274	1,800
Lower Light Fairing Removed	.004853 .005611	0.15				274	1,780
Standard	.004853 .005611	N/A				274	1,800

<sup>1</sup>Variations in C<sub>T</sub> values are due to small variations in average gross weight.

<sup>2</sup>Recommended cruise speed is defined as the highest airspeed which results in 90 percent of the maximum range. Range calculations were made at this airspeed.

<sup>3</sup>Range calculations are based on the following: 400 pounds of usable fuel; 10 percent of fuel reserve at landing; 15 pounds of fuel for start, taxi, takeoff and climb to 5000 ft. 22 pounds of fuel for start, taxi, takeoff and climb to 10,000 ft.

power limit airspeed on a standard day at 5000 feet and a 7-knot (6.2 percent) decrease at 10,000 feet.

18. Individually removing the lower anticollision light cover, the cover for the center of the main rotor hub and the fairings on the main rotor root ends did not produce any significant changes in performance. Removal of the skid strut fairings resulted in a significant decrease in performance.

## STABILITY AND CONTROL

### Trim Stability

19. Figure 15, appendix II, shows the variation in control positions between the clean configuration and the all fairings off configuration. These trim curves were taken from the 5000-foot  $H_D$  level-flight tests. The most significant variation shows up on collective stick position. The increase in blade angle of attack necessary to compensate for the additional drag caused by removing the fairings is shown by the increase in collective stick position.

20. The longitudinal stick-position trim curve shows a more forward stick position required for the fairings off configuration at speeds above 80 knots calibrated airspeed (KCAS).

### Static Longitudinal Collective-Fixed Stability

21. Static longitudinal collective-fixed stability tests were conducted at a 5000-foot  $H_D$ . The trim airspeeds flown were 53 KCAS, 80 KCAS ( $.8V_{NE}$ ) and 99 KCAS ( $V_{NE}$ ). Results are shown in figure 17, appendix II.

22. The slopes of the curves were not changed by removing all fairings which indicated that the static longitudinal collective-fixed stability was unchanged. Removal of the fairings resulted in increased collective control and more forward cyclic control for a given airspeed.

### Static Lateral-Directional Stability

23. Static lateral-directional stability flights were conducted in the clean configuration and with all four fairings removed at a density altitude of approximately 5000 feet. The trim airspeeds flown were 53, 80 and 99 KCAS. Tests were conducted at sideslip angles from approximately 10 degrees at high speed to 25 degrees at low speed. Test results are presented in figure 19, appendix II.

24. The most significant difference between the two configurations is the difference in lateral-stick requirement. More lateral stick is required for a given sideslip angle in the fairings removed configuration. This indicates an increase in dihedral effect with the fairings removed. The bank angles remain approximately the same for both configurations despite the increase in lateral-stick position for the fairings removed configuration. The variations in longitudinal stick position and pedal position were not significant.

#### Dynamic Stability and Controllability

25. Dynamic stability and controllability tests were flown in both the clean and all fairings off configurations. The controllability flights were conducted at a 6000-foot  $H_D$ , and the dynamic stability flights were made at a 5000-foot  $H_D$ . The trim airspeeds flown were approximately 50, 80 and 95 KCAS.

26. The qualitative results of these flights indicate no significant change in the stability and control characteristics with the fairings removed. Blade stall limits were reached at lower airspeeds, but no unusual tendencies were observed with all of the fairings removed.

## CONCLUSIONS

27. It is feasible to operate the OH-6A helicopter with fairings removed individually and collectively (para 12).

28. Removal of all fairings reduced the recommended cruise speed by 5 knots (5 percent) at a 5000-foot  $H_p$  and decreased the range approximately 27 nautical air miles (10 percent) (table 1).

29. Removal of the skid strut fairings reduced the recommended cruise speed by 5 knots (5 percent) at a 5000-foot  $H_p$  and decreased the range approximately 21 nautical air miles (7 percent) (table 1).

30. The lower anticollision light cover, the center hub fairing and the blade root fairings did not significantly affect the performance of the OH-6A when removed individually (para 18).

31. The stability and control characteristics of the OH-6A helicopter were not degraded by removal of all fairings (paras 19-26).

## RECOMMENDATIONS

- 32. It is recommended that the data pertaining to the reduced performance of the OH-6A with fairings removed be included in TM 55-1520-214-10.



## APPENDIX I. REFERENCES

1. Message, 'USAAVSCOM, AMSAV-ER, unclas, subject, Test Directive, "OH-6A Evaluation Tests with Fairings Removed," 27 December 1967.
2. Technical Manual, TM 55-1520-214-10, *Helicopter Observation OH-6A (Hughes)*, January 1967.
3. Specification, HHC-AD-369-Y-8011, Hughes Tool Company, Aircraft Division, *Detail Specification for a Single Engine, Single-Main-Rotor, Light Observation Helicopter Army Model Designation OH-6A*, 25 September 1967.
4. Specification, Allison Division of General Motors Corporation, *Model Specification No. 580-F, Amendment No. 1, Model T63-A-5A*, 18 August 1965.
5. Final Report, USAAVNTA, Project Nos 65-37 and 65-41, *Engineering Flight Test (Product Improvement Test) of Production OH-6A Helicopter, Unarmed and Armed with XM-27E1 Weapon System, Phase D*, March 1968.
6. Final Report, USAASTA, Project No. 67-13, *Engineering Flight Test of the Light Observation Helicopter (LOH) OH-6A*, December 1967.
7. Military Specification, MIL-H-8501A, *Helicopter Flying and Ground Handling Qualities, General Requirements For*, 3 April 1962.

## **APPENDIX II. TEST DATA**

**FIGURE 1**  
**AIRSPPEED CALIBRATION**  
**OH-6A S/N 65-12927**  
**CLEAN CONFIGURATION**  
**BOOM SYSTEM**

DENSITY ALTITUDE FT	GROSS WEIGHT LB	ROTOR SPEED RPM	C.G. LOCATION		FLIGHT CONDITION
			LONG IN	LAT	
2320	2260	483	100.3 (Mid)	0 (Mid)	Level Flight

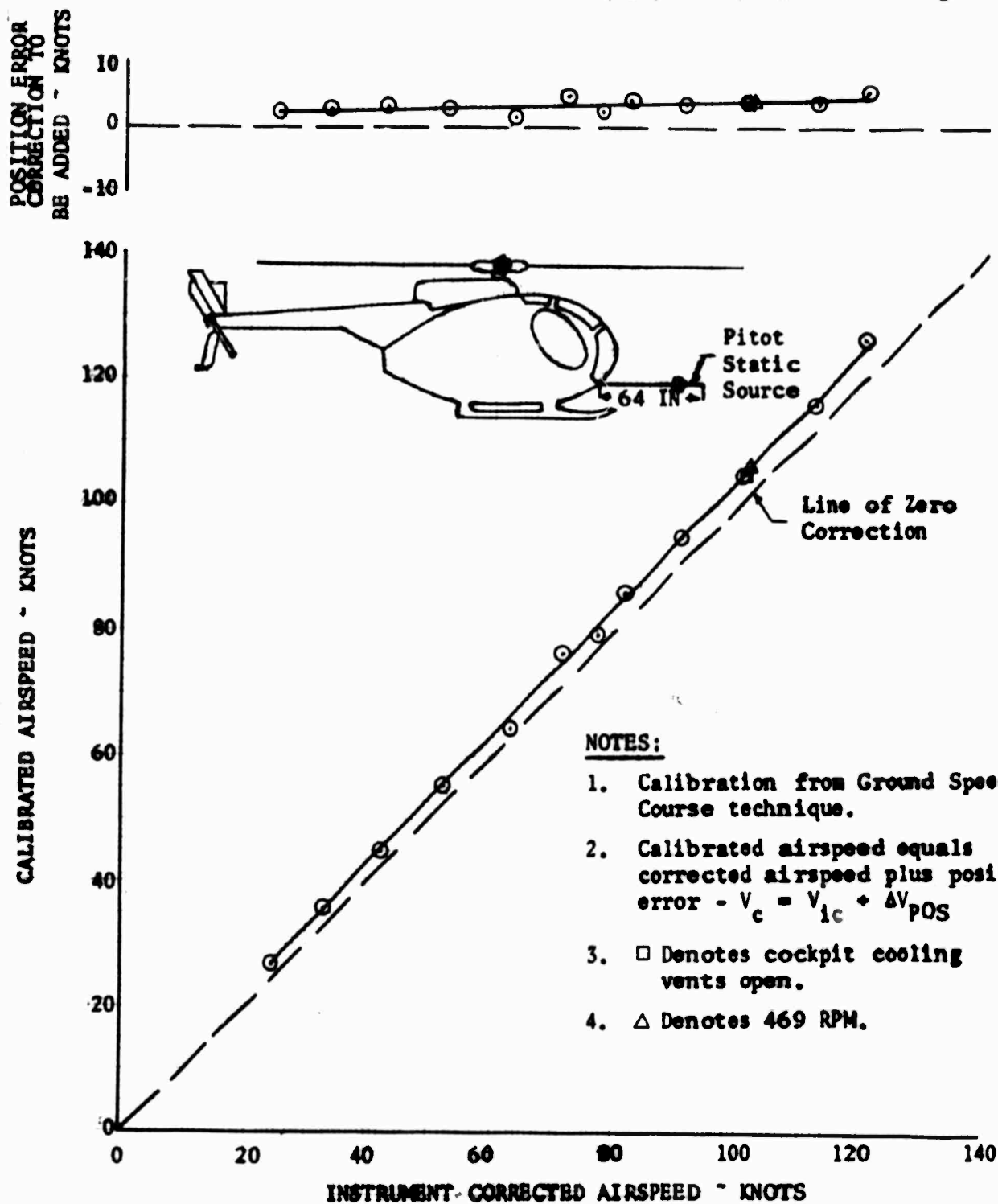


FIGURE 2  
LEVEL FLIGHT PERFORMANCE  
OH-6A 8/N 65-12927  
CLEAN CONFIGURATION

GROSS WEIGHT = 2410 LB  
DENSITY ALTITUDE = 5000 FT  
ROTOR SPEED = 483 RPM  
C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .004867

SPECIFIC RANGE  
NAUTICAL AIR MILE/LB FUEL

1.0  
.8  
.6  
.4  
.2

CURVE DERIVED FROM  
SPEC. FUEL FLOW (FIGURE 14)

ENGINE OUTPUT SHAFT HORSEPOWER

220  
200  
180  
160  
140  
120  
100  
80  
60  
40  
20  
0

0 20 40 60 80 100 120 140

TRUE AIRSPEED - KNOTS

# LEVEL FLIGHT PERFORMANCE

OH-6A S/N 65-12927

CLEAN CONFIGURATION

GROSS WEIGHT = 2398 LB

DENSITY ALTITUDE = 10,000 FT

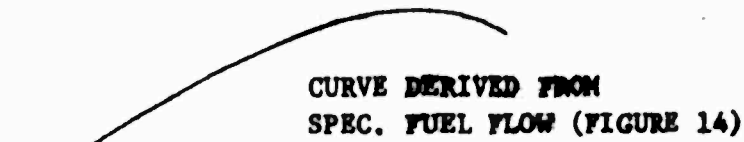
ROTOR SPEED = 483 RPM

C.G. LOCATION = STATION 100.0 (MID)

$C_T$  = .005650

SPECIFIC RANGE  
NAUTICAL MILE/LB FUEL

1.0  
0.8  
0.6  
0.4  
0.2



ENGINE OUTPUT SHAFT HORSEPOWER

220  
200  
180  
160  
140  
120  
100  
80  
60  
40  
20  
0

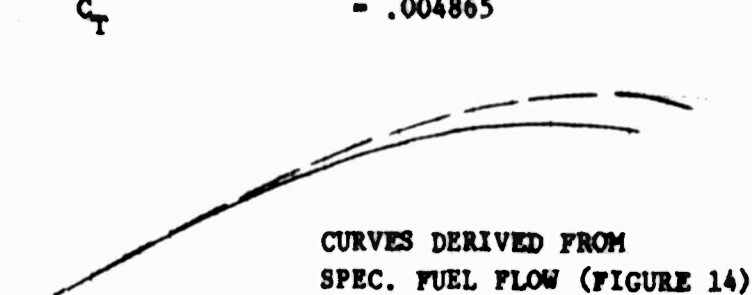
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140

TRUE AIRSPEED - KNOTS

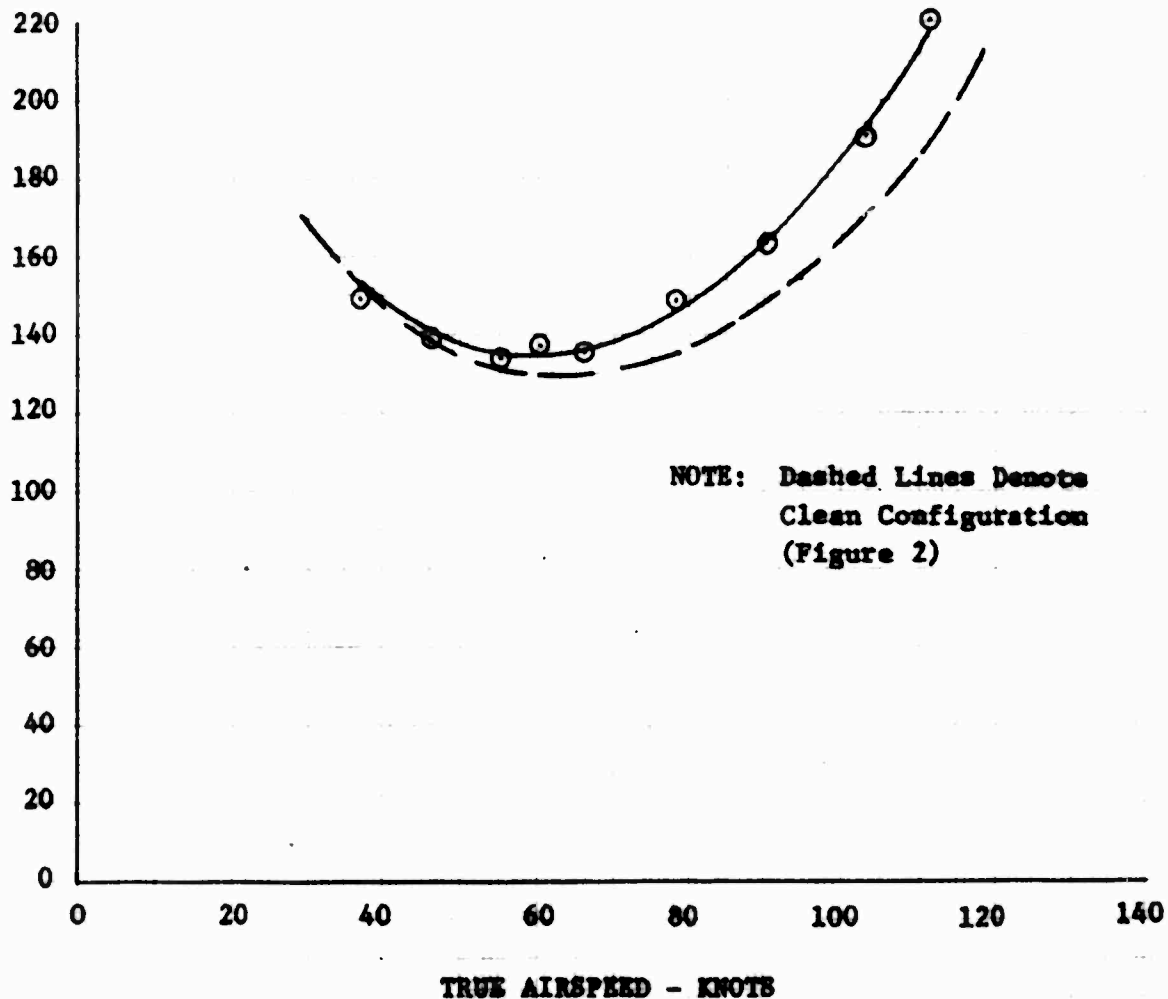
FIGURE 7  
**LEVEL FLIGHT PERFORMANCE**  
**OH-6A S/N 65-12927**  
**ALL FAIRINGS REMOVED**

GROSS WEIGHT = 2409 LB  
 DENSITY ALTITUDE = 5000 FT  
 ROTOR SPEED = 483 RPM  
 C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .004865

SPECIFIC RANGE  
NAUTICAL MILE/LB FUEL



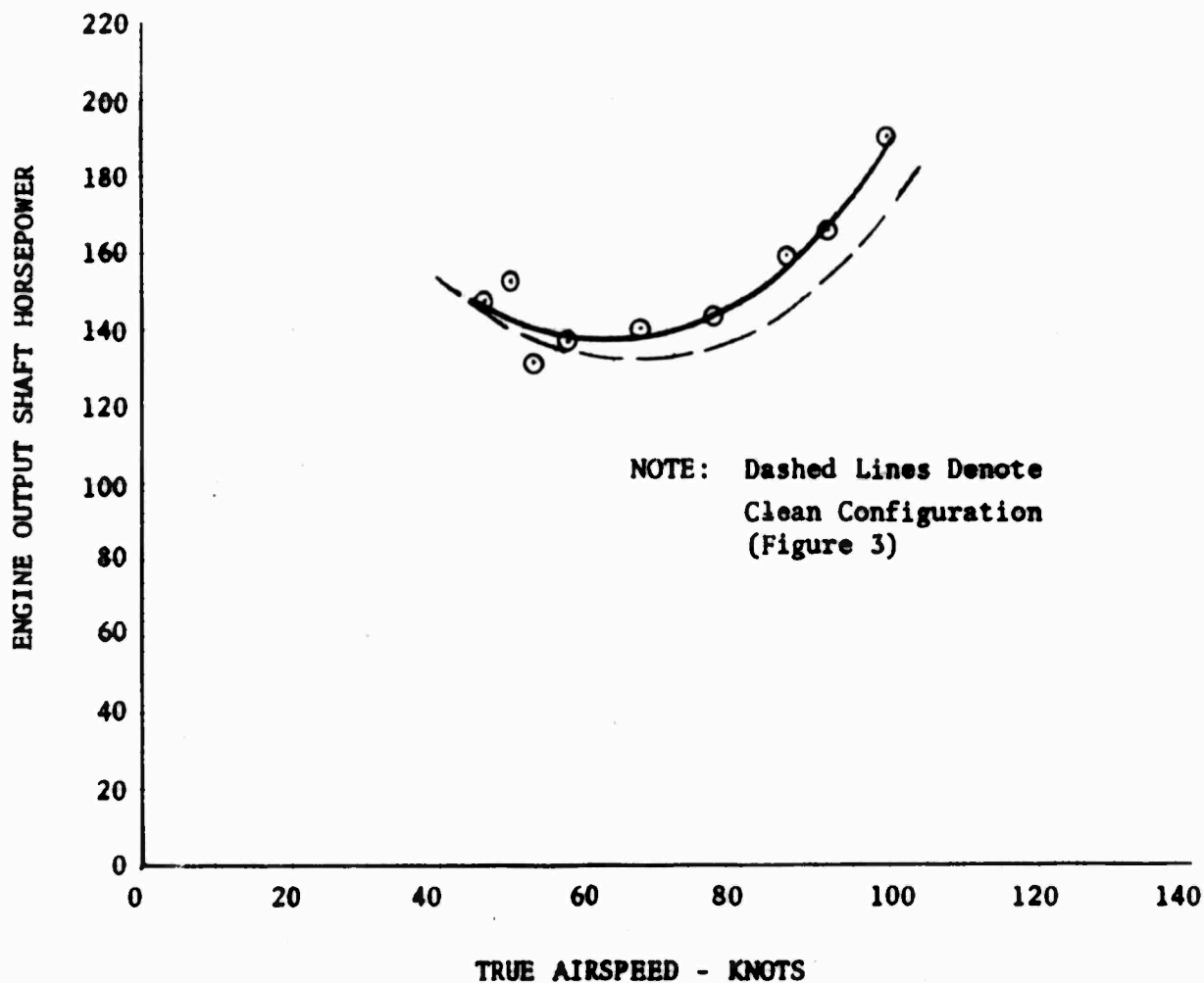
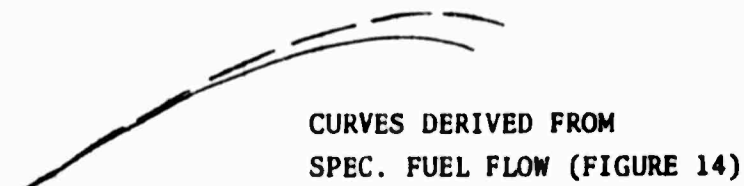
ENGINE OUTPUT SHAFT HORSEPOWER



LEVEL FLIGHT PERFORMANCE  
OH-6A S/N 65-12927  
ALL FAIRINGS REMOVED

GROSS WEIGHT = 2397 LB  
DENSITY ALTITUDE = 10,000 FT  
ROTOR SPEED = 483 RPM  
C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .005648

SPECIFIC RANGE  
NAUTICAL MILE/LB FUEL



LEVEL FLIGHT PERFORMANCE  
OH-6A S/N 65-12927  
LOWER ANTI-COLLISION LIGHT COVER REMOVED

GROSS WEIGHT = 2403 LB  
DENSITY ALTITUDE = 5000 FT  
ROTOR SPEED = 483 RPM  
C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .004853

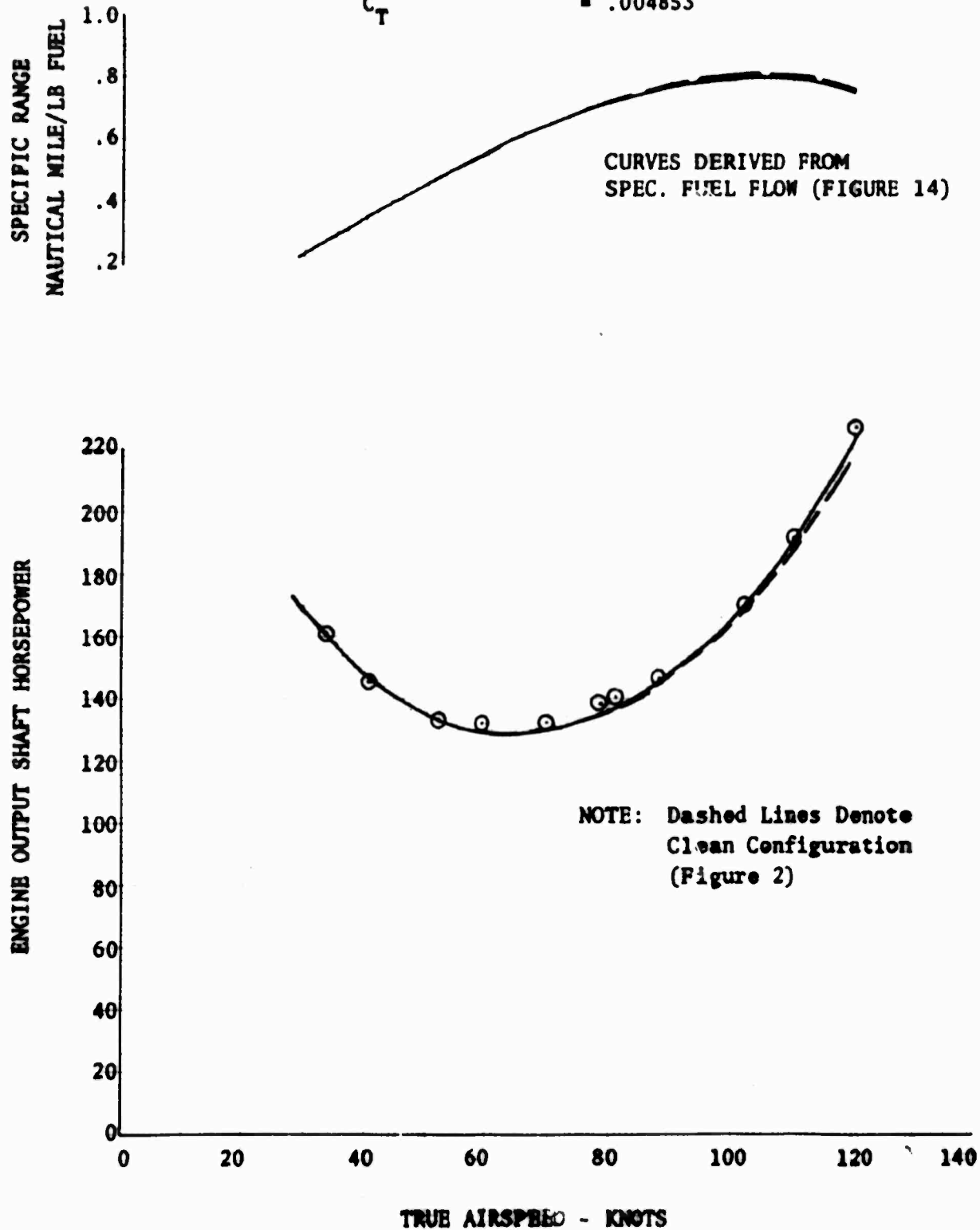
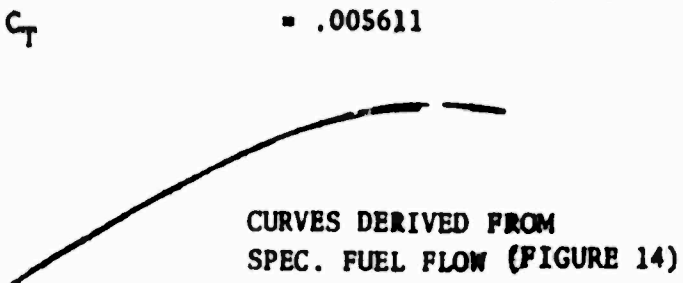




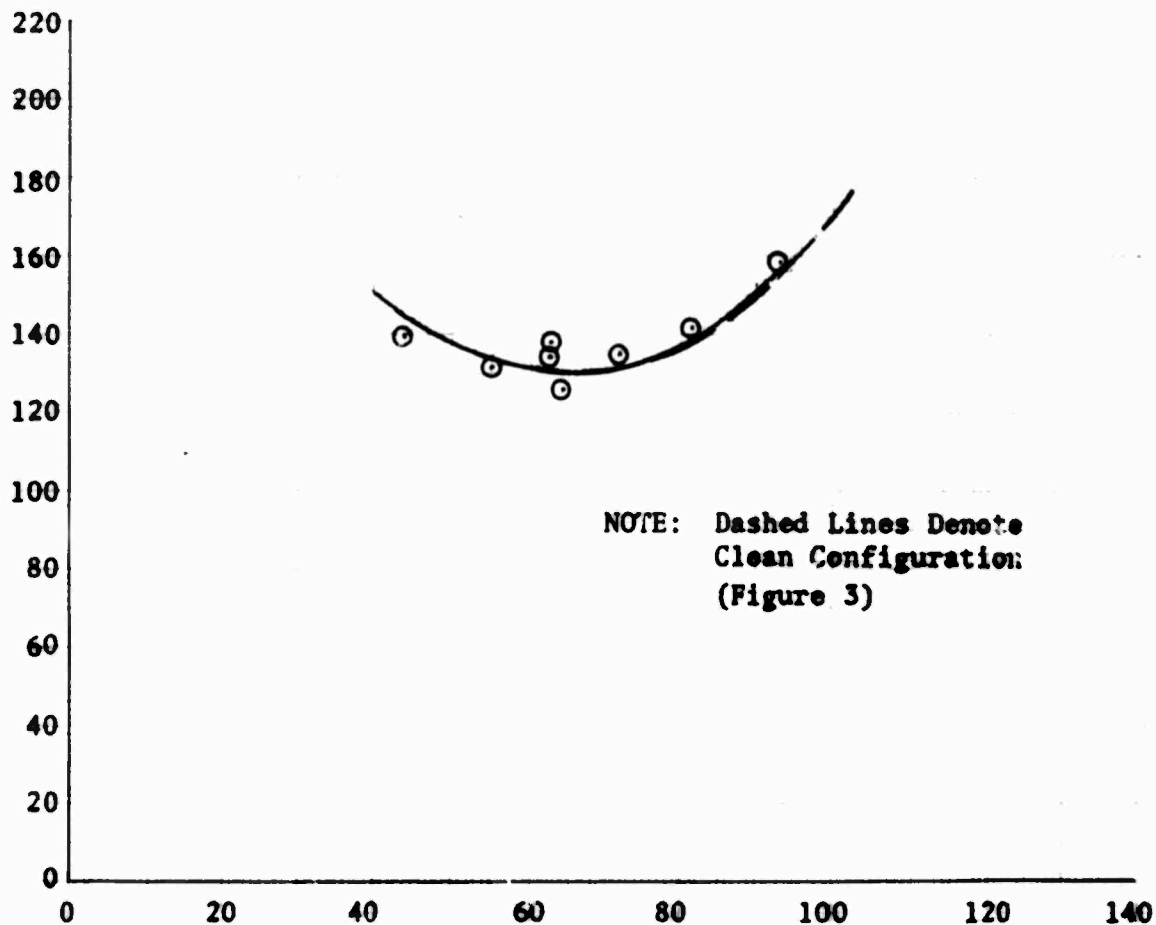
FIGURE 7  
 LEVEL FLIGHT PERFORMANCE  
 OH-6A S/N 65-12927  
 LOWER ANTI-COLLISION LIGHT COVER REMOVED

GROSS WEIGHT = 2381 LB  
 DENSITY ALTITUDE = 10,000 FT  
 ROTOR SPEED = 483 RPM  
 C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .005611

SPECIFIC RANGE  
 NAUTICAL MILE/LB FUEL



ENGINE OUTPUT SHAFT HORSEPOWER



TRUE AIRSPEED - KNOTS

**FIGURE 8**  
**LEVEL FLIGHT PERFORMANCE**  
**OH-6A S/N 65-12927**  
**MAIN ROTOR BLADE ROOT END FAIRINGS REMOVED**

GROSS WEIGHT = 2412 LB  
 DENSITY ALTITUDE = 5000 FT  
 ROTOR SPEED = 483 RPM  
 C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .004871

SPECIFIC RANGE  
 NAUTICAL MILE/LB FUEL

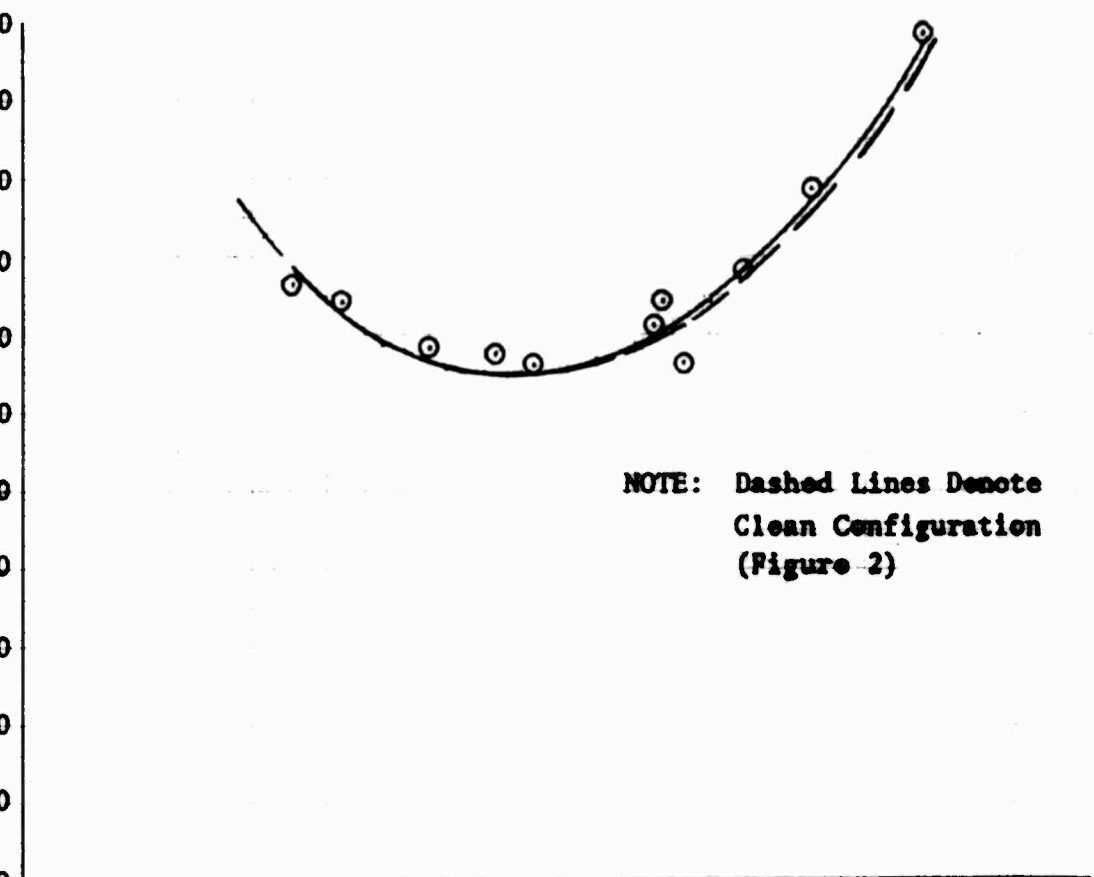
1.0  
 .8  
 .6  
 .4  
 .2



CURVES DERIVED FROM  
 SPEC. FUEL FLOW (FIGURE 14)

ENGINE OUTPUT SHAFT HORSEPOWER

220  
 200  
 180  
 160  
 140  
 120  
 100  
 80  
 60  
 40  
 20  
 0



NOTE: Dashed Lines Denote  
 Clean Configuration  
 (Figure 2)

0 20 40 60 80 100 120 140

TRUE AIRSPEED - KNOTS

FIGURE 9  
 LEVEL FLIGHT PERFORMANCE  
 OH-6A S/N 65-12927  
 MAIN ROTOR BLADE ROOT END FAIRINGS REMOVED

GROSS WEIGHT = 2397 lb  
 DENSITY ALTITUDE = 10,000 ft  
 ROTOR SPEED = 483 rpm  
 C. G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .005649

SPECIFIC RANGE  
 NAUTICAL MILE/LB FUEL

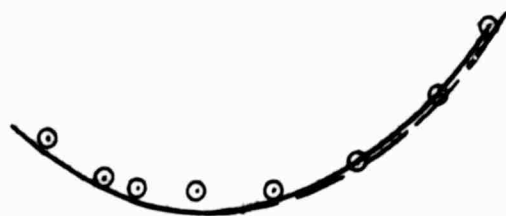
1.0  
 0.8  
 0.6  
 0.4  
 0.2



CURVES DERIVED FROM  
 SPEC FUEL FLOW (FIGURE 14)

ENGINE OUTPUT SHAFT HORSEPOWER

220  
 200  
 180  
 160  
 140  
 120  
 100  
 80  
 60  
 40  
 20  
 0



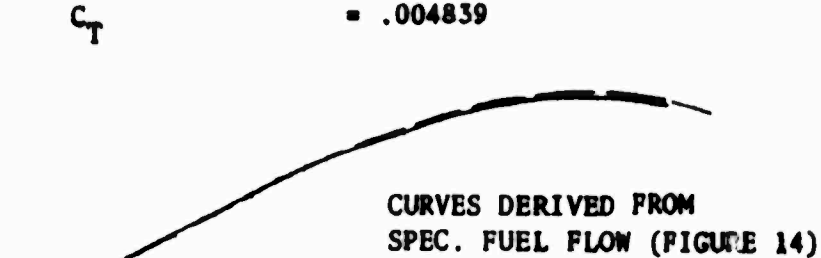
NOTE: DASHED LINES DENOTE CLEAN  
 CONFIGURATION (FIGURE 3)

TRUE AIRSPEED ~ KNOTS

**FIGURE 10**  
**LEVEL FLIGHT PERFORMANCE**  
**OH-6A S/N 65-12927**  
**MAIN ROTOR CENTER HUB FAIRING REMOVED**

GROSS WEIGHT     ▪ 2396 LB  
 DENSITY ALTITUDE ▪ 5000 FT  
 ROTOR SPEED       ▪ 483 RPM  
 C.G. LOCATION     ▪ STATION 100.0 (MID)  
 $C_T$                ▪ .004839

SPECIFIC RANGE  
 NAUTICAL MILE/LB FUEL



ENGINE OUTPUT SHAFT HORSEPOWER

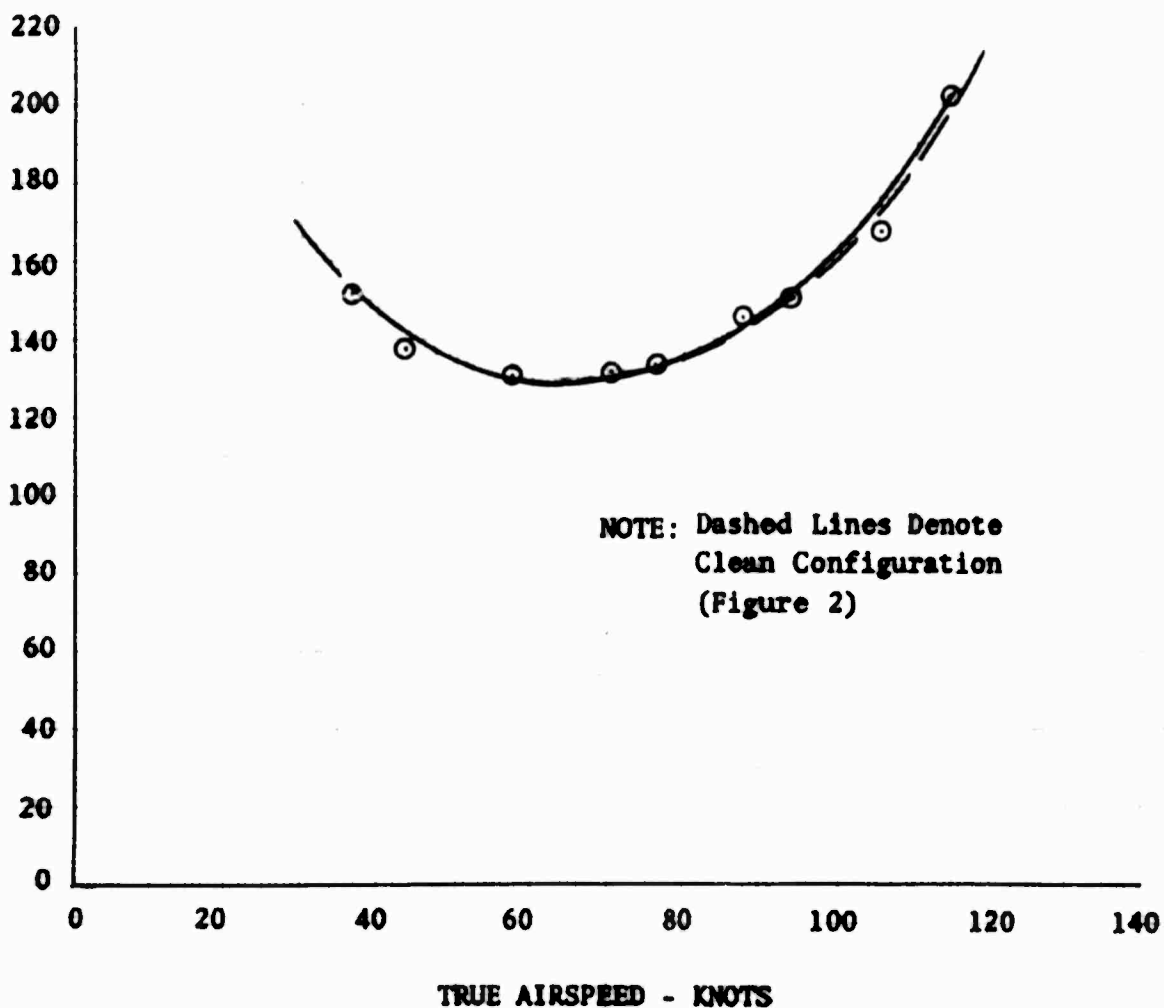
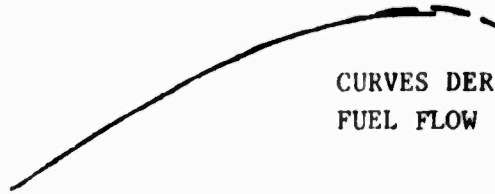


FIGURE 11  
 LEVEL FLIGHT PERFORMANCE  
 OH-6A S/N 65-12927  
 MAIN ROTOR CENTER HUB FAIRING REMOVED

GROSS WEIGHT = 2401 LB  
 DENSITY ALTITUDE = 10,000 FT  
 ROTOR SPEED = 483 RPM  
 C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .005658

SPECIFIC RANGE -  
NAUTICAL MILE/LB FUEL

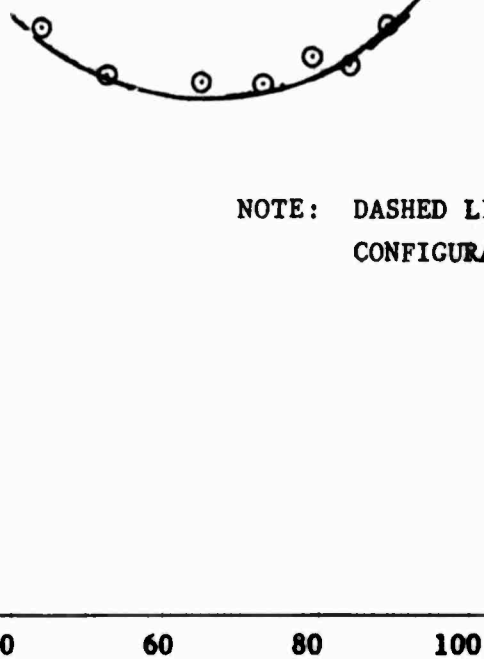
1.0  
.8  
.6  
.4  
.2



CURVES DERIVED FROM SPEC  
FUEL FLOW (FIGURE 14)

ENGINE OUTPUT SHAFT HORSEPOWER

220  
200  
180  
160  
140  
120  
100  
80  
60  
40  
20  
0



NOTE: DASHED LINES DENOTE CLEAN  
CONFIGURATION (FIGURE 3)

TRUE AIRSPEED - KNOTS

0 20 40 60 80 100 120 140

**FIGURE 12**  
**LEVEL FLIGHT PERFORMANCE**  
**OH-6A S/N 65-12927**  
**LANDING GEAR STRUT FAIRINGS REMOVED**

**GROSS WEIGHT** = 2406 lb  
**DENSITY ALTITUDE** = 5000 ft  
**ROTOR SPEED** = 483 rpm  
**C. G. LOCATION** = STATION 100.0 (MID)  
**C<sub>T</sub>** = .004858

SPECIFIC RANGE  
NAUTICAL MILE/LB FUEL

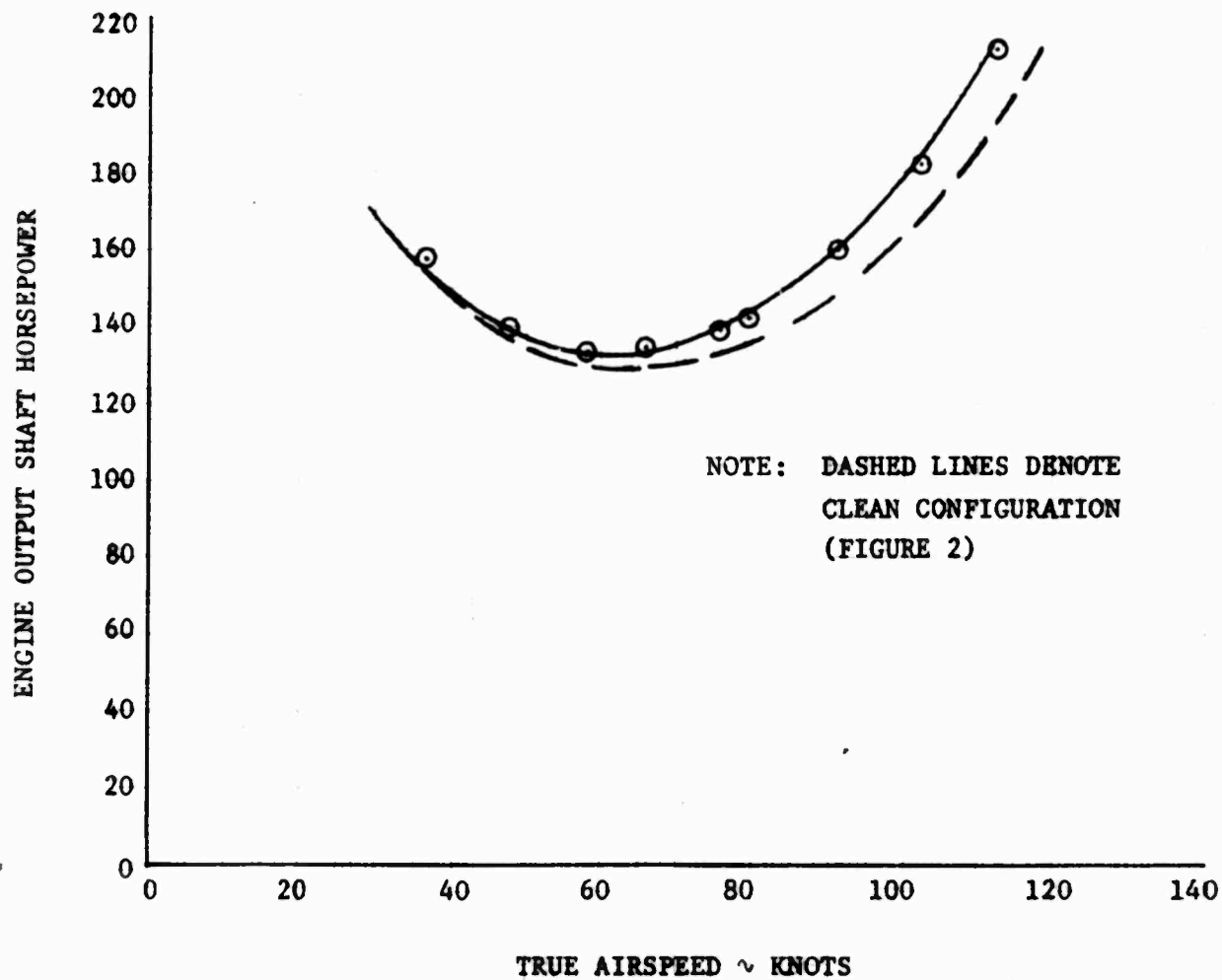
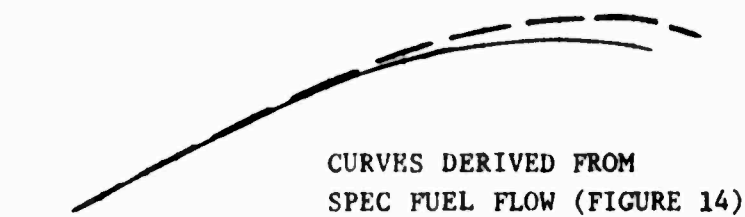
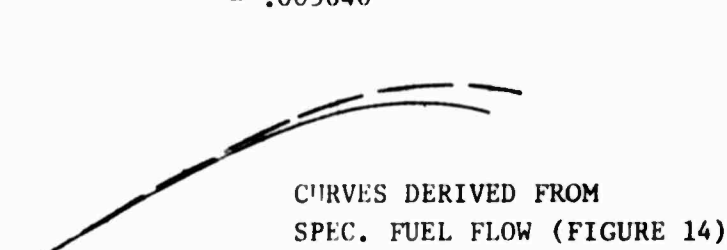


FIGURE 13  
 LEVEL FLIGHT PERFORMANCE  
 OH-6A S/N 65-12927  
 LANDING GEAR STRUT FAIRINGS REMOVED

GROSS WEIGHT = 2394 lb  
 DENSITY ALTITUDE = 10,000 ft  
 ROTOR SPEED = 483 rpm  
 C.G. LOCATION = STATION 100.0 (MID)  
 $C_T$  = .005640

SPECIFIC RANGE  
NAUTICAL MILE/LB FUEL



ENGINE OUTPUT SHAFT HORSEPOWER

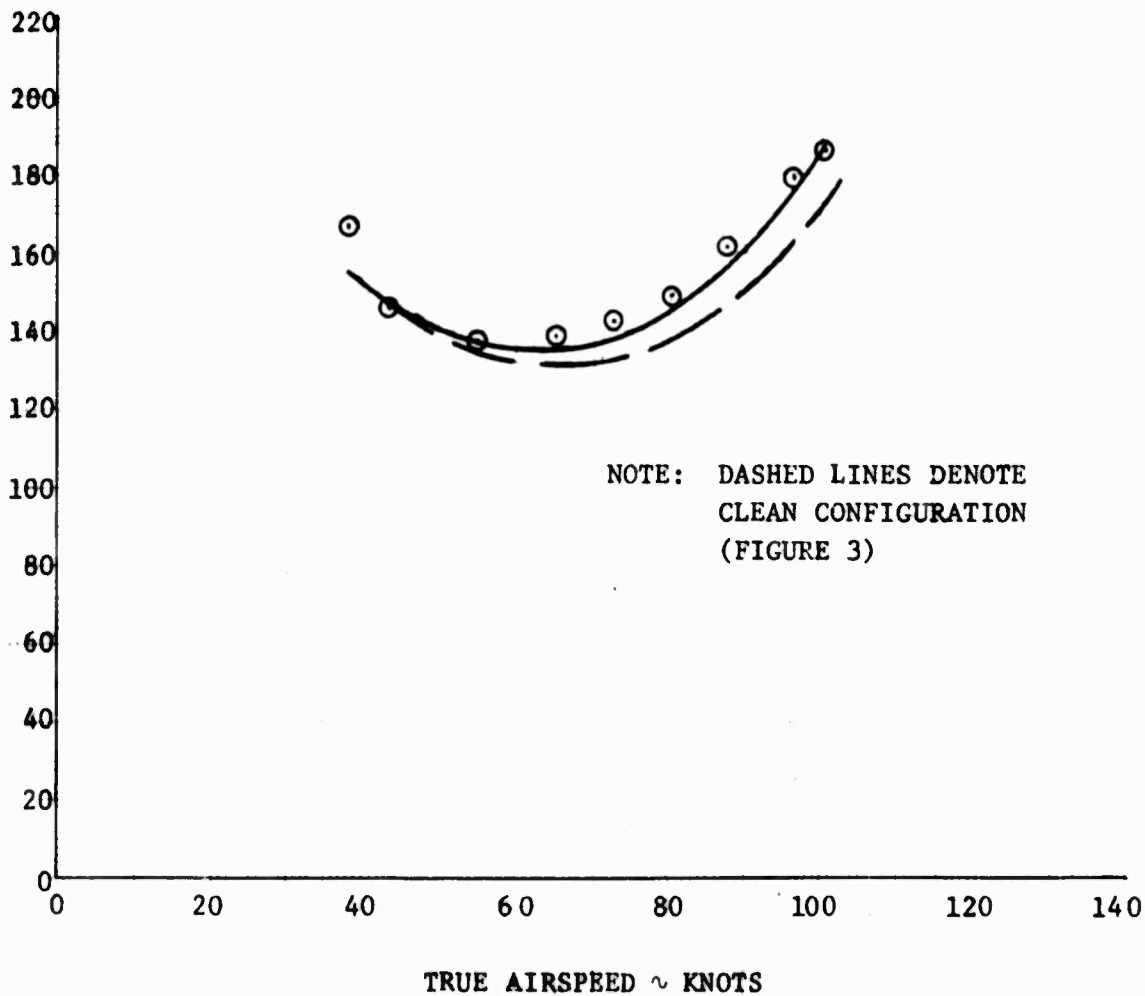
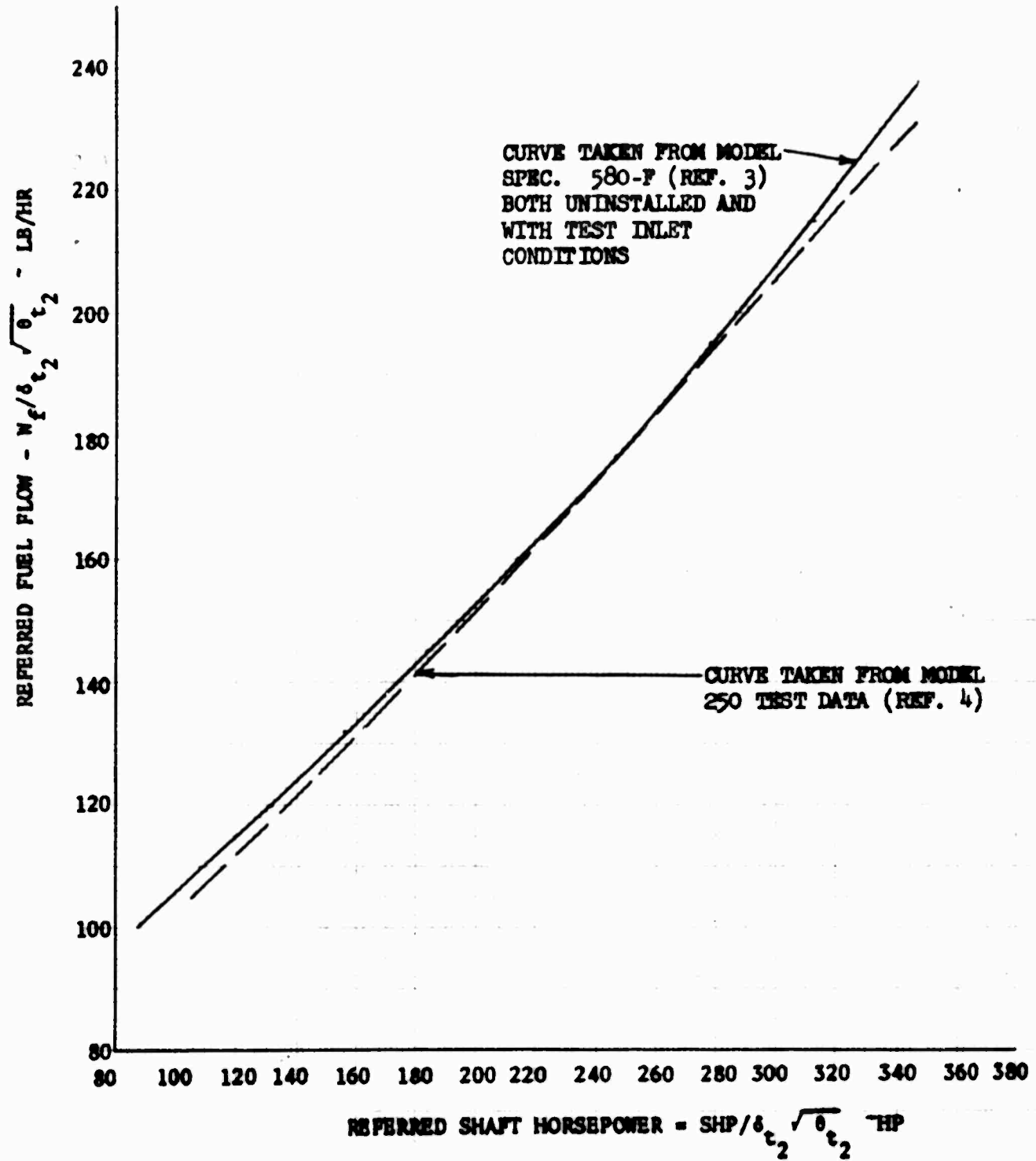


FIGURE 24  
ENGINE CHARACTERISTICS  
OH-6A S/N 65-12927  
T63-A-5A



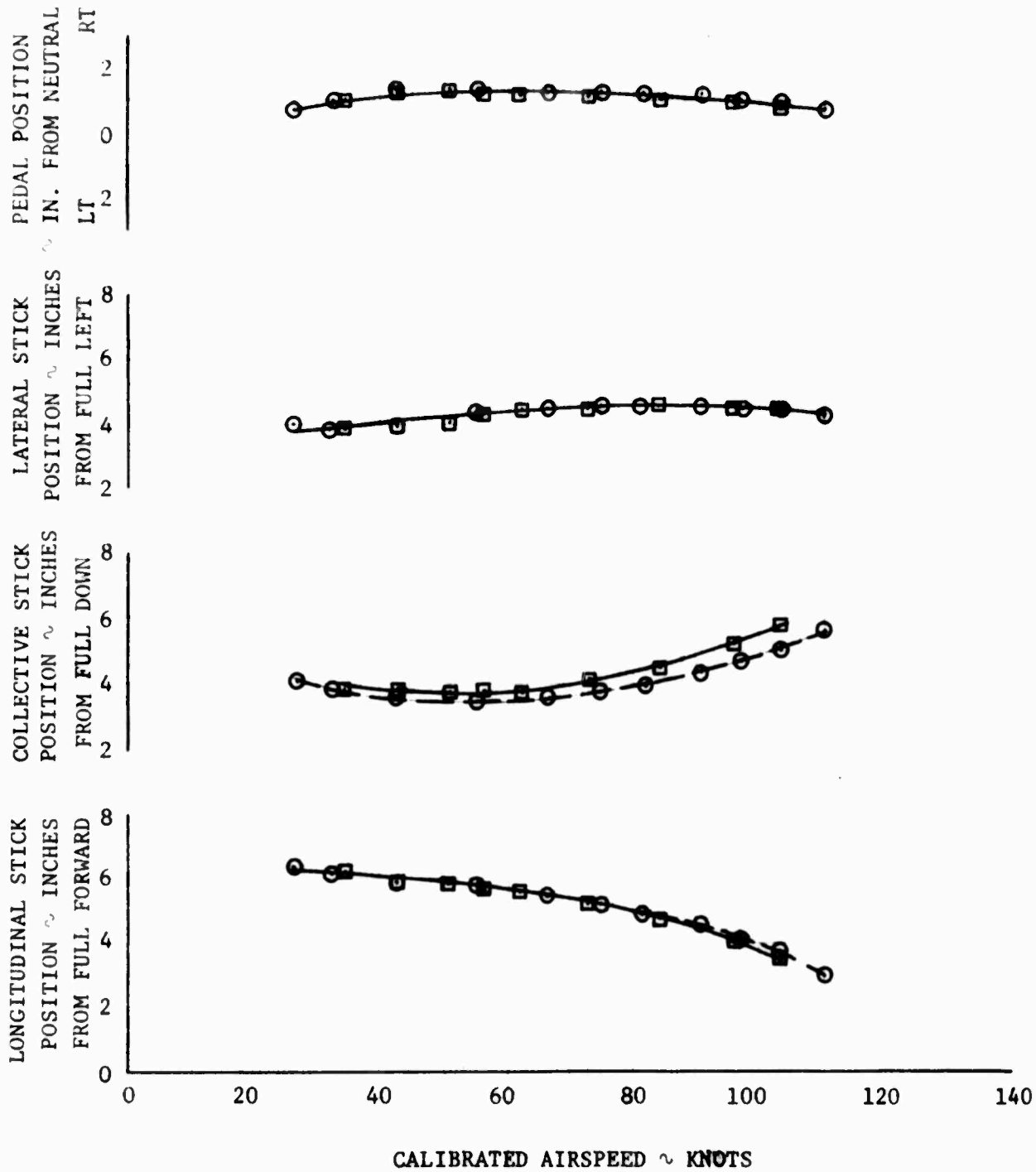


# CONTROL POSITIONS IN FORWARD FLIGHT

OH-6A S/N 65-12927

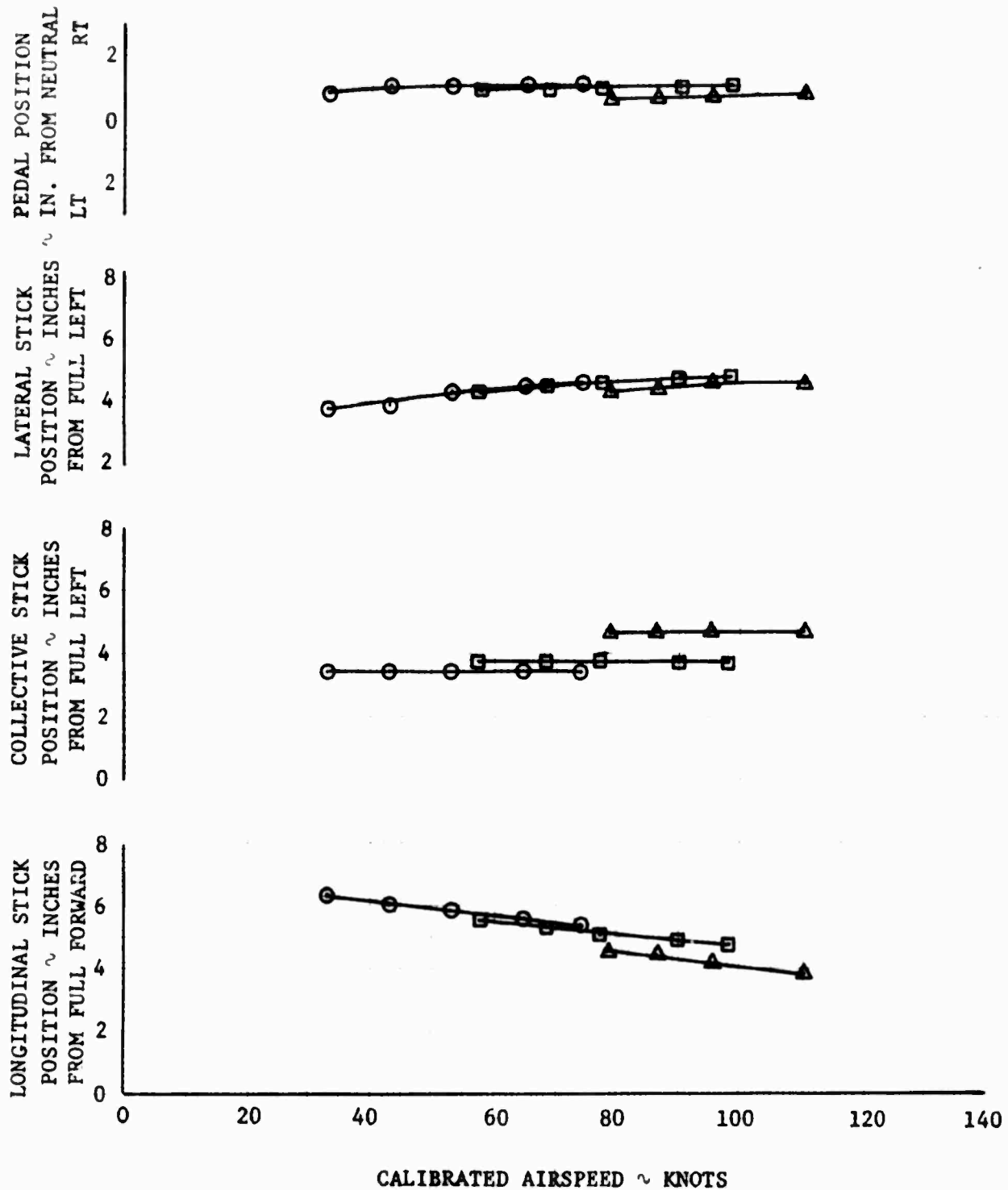
## LEVEL FLIGHT

SYMBOL	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)	CONFIGURATION
○	4870	2410	483	100.0 (MID)	CLEAN
□	4980	2400	483	100.0 (MID)	ALL FAIRINGS REMOVED



STATIC LONGITUDINAL COLLECTIVE FIXED STABILITY  
OH-6A S/N 65-12927  
CLEAN CONFIGURATION

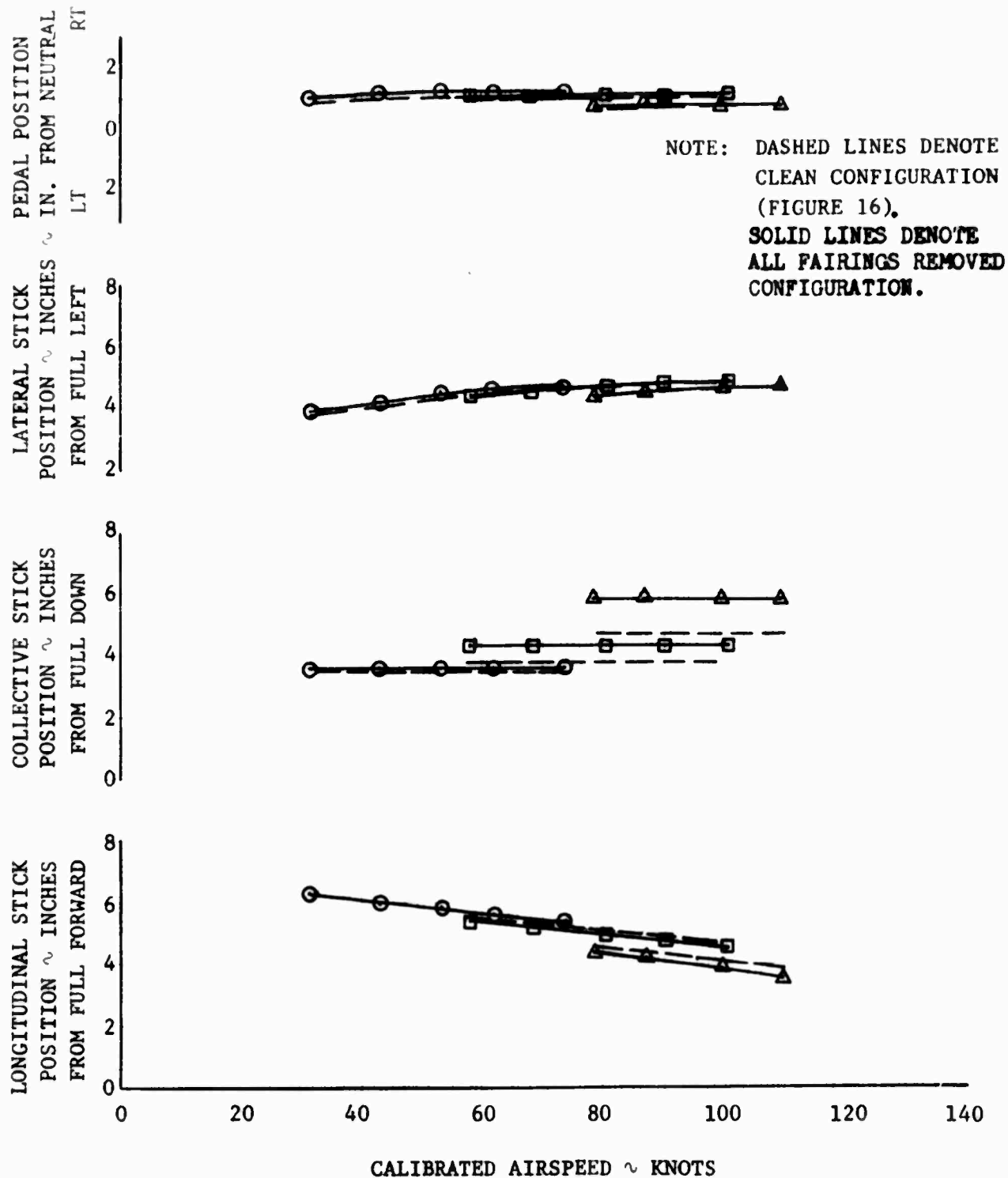
SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
○	53.0	5050	2410	483	100.0 (MID)
□	77.3	5090	2430	483	100.0 (MID)
△	95.3	5480	2390	483	100.0 (MID)



# STATIC LONGITUDINAL COLLECTIVE-FIXED STABILITY

OH-6A S/N 65-12927

	TRIM	DENSITY	GROSS	ROTOR	C.G.
	AIRSPPEED	ALTITUDE	WEIGHT	SPEED	LOCATION
SYMBOL	(KCAS)	(FT)	(LB)	(RPM)	(IN.)
○	53.0	5220	2350	483	100.0 (MID)
□	80.5	4800	2410	483	100.0 (MID)
△	99.3	5360	2380	483	100.0 (MID)



	TRIM	DENSITY	GROSS	ROTOR	C.G.
	AIRSPED	ALTITUDE	WEIGHT	SPEED	LOCATION
SYMBOL	(KCAS)	(FT)	(LB)	(RPM)	(IN.)
○	52.9	5210	2410	483	100.0 (MID)
□	78.0	5290	2430	483	100.0 (MID)
△	99.1	5300	2380	483	100.0 (MID)

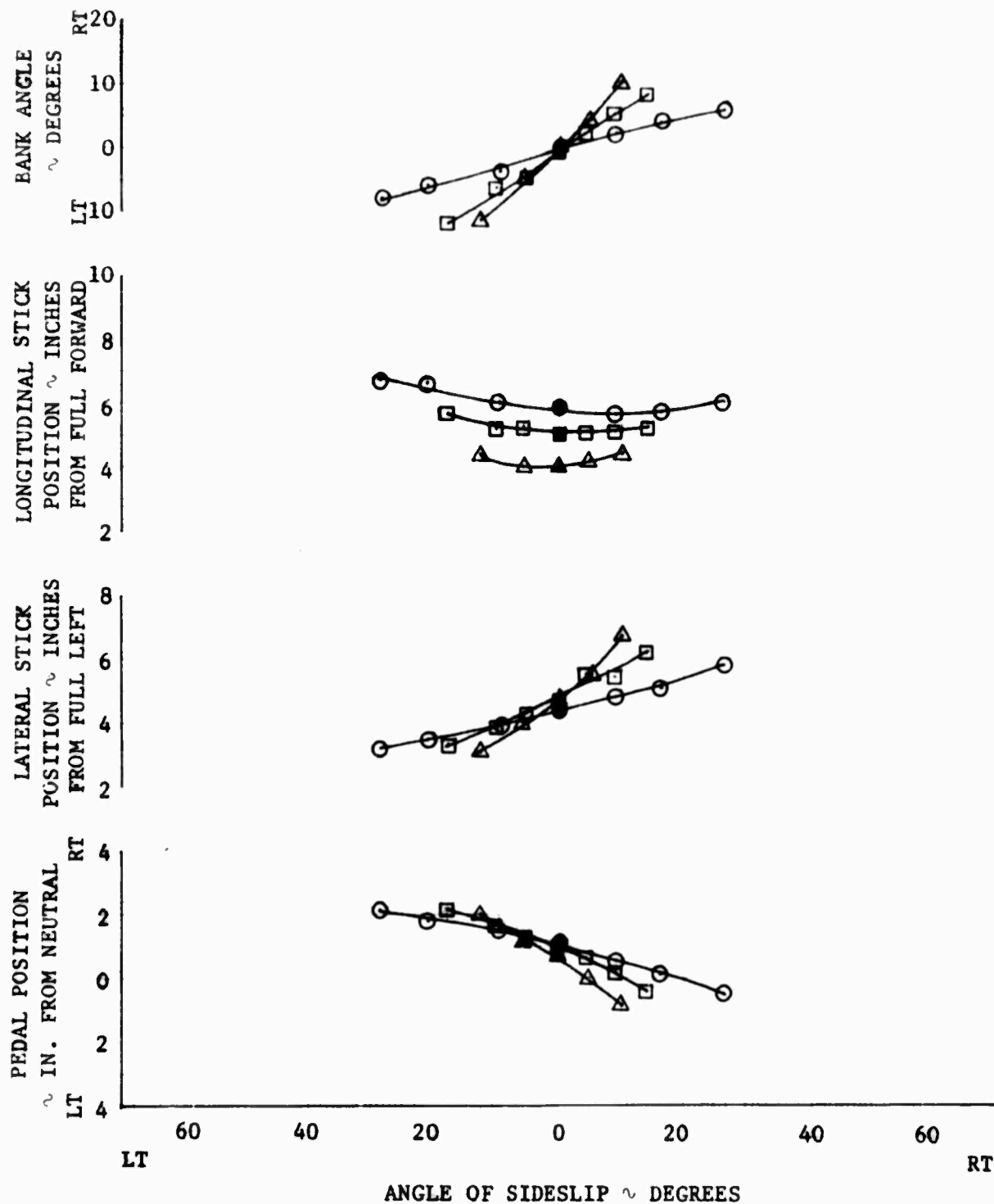
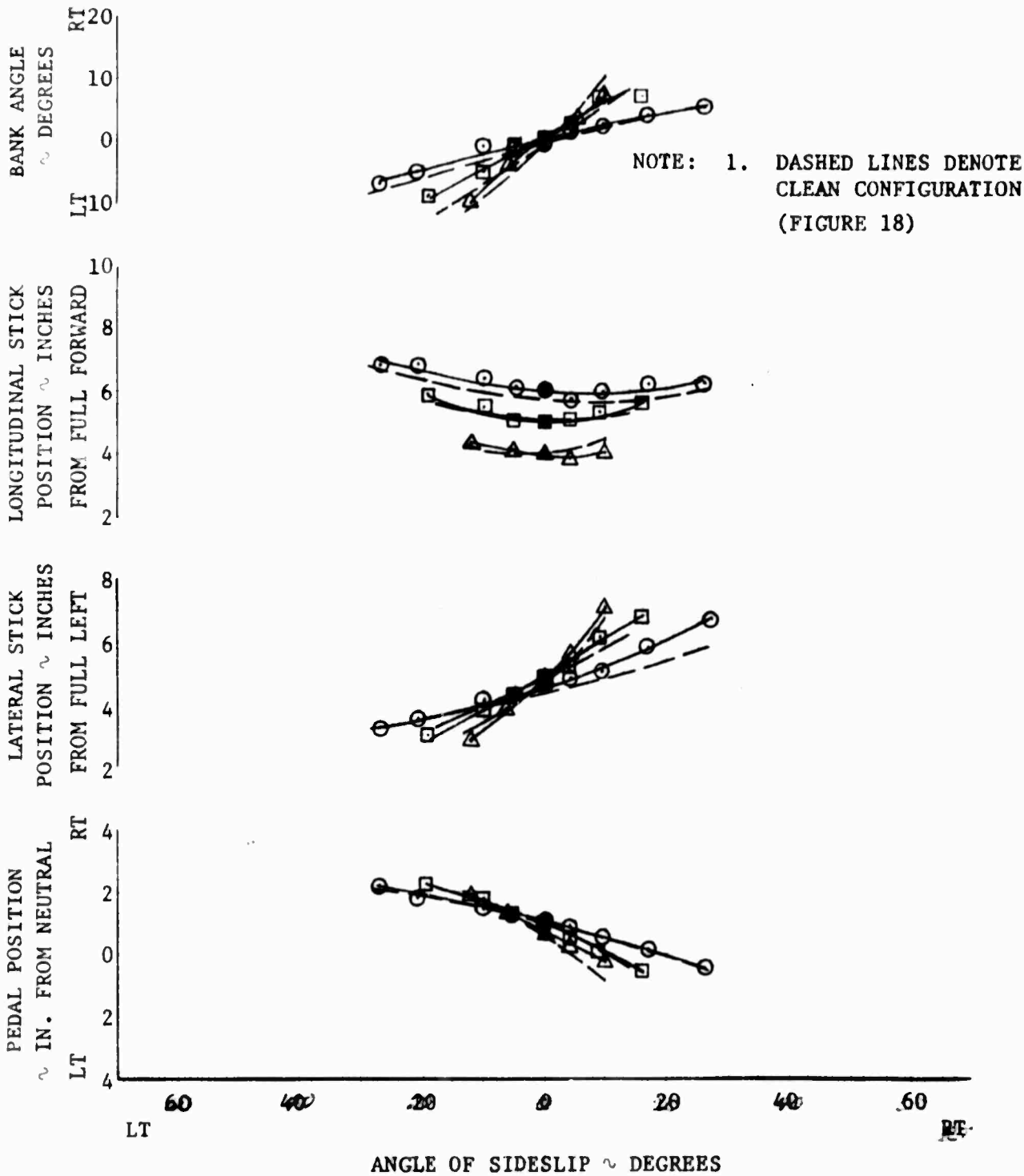


FIGURE 19  
 STATIC LATERAL-DIRECTIONAL STABILITY  
 OH-6A S/N 65-12927  
 ALL FAIRINGS REMOVED

SYMBOL	TRIM AIRSPEED (KCAS)	DENSITY ALTITUDE (FT)	GROSS WEIGHT (LB)	ROTOR SPEED (RPM)	C.G. LOCATION (IN.)
○	54.1	5230	2330	483	100.0 (MID)
□	76.3	5220	2420	483	100.0 (MID)
△	98.7	5310	2390	483	100.0 (MID)



## APPENDIX III. METHODS OF TEST

### AIRSPPEED CALIBRATION

A level flight airspeed calibration was accomplished over a measured ground course to determine the position error of the test boom and standard airspeed system. Reciprocal headings were flown at the same indicated airspeed, and the average lapsed time was used to correct for wind velocity and direction. Pressure and temperature measurements were used to obtain the air density ratio. The basic calibration was conducted at the normal-operating rotor speed and checked at the minimum rotor speed. Variations with ground proximity, gross weight, cg location and flight region were not determined.

### LEVEL FLIGHT

Level flight power required tests were conducted in the six different configurations. During each speed power flight as fuel was consumed, the altitude was adjusted so that a constant ratio of weight to density ( $W/\rho$ ) was maintained. Rotor speed was also held constant so that all points on a specific curve were flown at a constant  $C_T$ . Pressure altitude, free air temperature, rotor speed, engine torque, turbine outlet temperature and fuel used were manually recorded at each stabilized level flight speed. Speed was varied incrementally throughout the allowable speed range for each flight condition. The photopanel was used to record engine characteristics, and the oscillograph data were used to establish the trim control positions.

### STATIC TRIM STABILITY

Tests were conducted to determine the static longitudinal trim stability and flying qualities at a series of trim airspeeds in level flight. When the aircraft was stabilized at a given speed during level flight testing, stick positions were recorded on an oscillograph.

### STATIC LONGITUDINAL COLLECTIVE-FIXED STABILITY

Static longitudinal collective-fixed stability tests were conducted to quantitatively measure the static stability characteristics and flying qualities as airspeed was varied about a trim airspeed at a

fixed collective setting. The aircraft was trimmed at the desired airspeed and the collective was locked in position. Airspeed was then incrementally varied through a specified range. Cyclic and directional control was used as required to achieve the necessary airspeed changes. The control positions were recorded on an oscillograph while atmospheric data, airspeed and rotor speed were recorded manually and by a photopanel.

#### STATIC LATERAL-DIRECTIONAL STABILITY

The static lateral-directional stability tests were conducted to determine the static directional stability and effective dihedral characteristics at various airspeeds and sideslip angles. The aircraft was trimmed at a desired airspeed, and the collective stick was locked in position. The heading and airspeed were maintained constant while the sideslip angle was varied both right and left. Control positions and aircraft attitudes were recorded on an oscillograph for each sideslip angle. Airspeed, atmospheric data and rotor speed were also recorded.

#### DYNAMIC STABILITY

The dynamic stability characteristics were determined from the aircraft motions resulting from a dynamic disturbance. An external disturbance was simulated by introducing a control pulse into the individual axis being investigated. Control position was fixed on all other axes. The pulse was initiated from a trim condition and consisted of a control input of approximately 1 inch which was then maintained for  $\frac{1}{2}$  to 1 second. The control was then returned to the trim position and held fixed until the motion had been established or recovery action was necessary.

#### CONTROLLABILITY

The controllability was determined by the resulting maximum angular rates and accelerations per inch of control input. The step input was accomplished by rapidly displacing the control and maintaining this control position until the maximum rates and accelerations were reached. All other controls were held fixed during the step input. The longitudinal, lateral and directional axes were evaluated with control inputs of approximately three-quarters of an inch.

## APPENDIX IV. TEST INSTRUMENTATION

A swivel-mounted pitot-static airspeed head was installed on a boom which extended approximately 5 feet in front of the nose of the helicopter. This airspeed head was used as a source for the sensitive altitude and airspeed systems. Vanes attached to the boom were used to measure angles of attack and sideslip. Sensitive instrumentation was installed to measure the following parameters:

### Pilot/Engineer Panel

- Boom system airspeed
- Ship airspeed
- Boom altitude
- Outside air temperature
- Rotor speed
- Torquemeter pressure
- Turbine outlet temperature
- Turbine compressor speed
- Fuel counts

### Photopanel

- Boom airspeed
- Boom altitude
- Outside air temperature
- Rotor speed
- Torquemeter pressure
- Compressor inlet temperature
- Compressor inlet pressure
- Fuel counts

### Oscillograph

- Pitch angle
- Pitch rate
- Yaw angle
- Yaw rate
- Roll angle
- Roll rate
- Collective stick position
- Cyclic stick position
- Pedal position
- Angle of attack
- Angle of sideslip
- CG normal acceleration
- Main rotor speed



## APPENDIX V. SYMBOLS & ABBREVIATIONS

<u>Abbreviation</u>	<u>Definition</u>	<u>Unit</u>
GRWT, grwt	Gross weight	Pounds
KCAS	Knots calibrated airspeed	Knots
KTAS	Knots true airspeed	Knots
NAMPP	Nautical air miles per pound of fuel	
RPM, rpm	Revolutions per minute	
SHP, shp	Shaft horsepower	

<u>Symbol</u>	<u>Definition</u>	<u>Unit</u>
CG, cg	Center of gravity	Inches
$C_T$	Thrust coefficient	Dimensionless
$H_D$	Density altitude	Feet
$V_C$	Knots calibrated airspeed	Knots
$V_{IC}$	Instrument corrected airspeed	Knots
$V_{NE}$	Never exceed airspeed	Knots
$V_T$	Knots true airspeed	Knots
$W_f$	Fuel flow	lb/hr
$\delta_{t_2}$	Pressure ratio	Ratio
$\Delta V_{POS}$	Airspeed position error	Knots
$\theta_{t_2}$	Temperature ratio	Ratio
$\rho$	Density	lb/sec <sup>2</sup> /ft <sup>4</sup>

## **APPENDIX VI. WEIGHT & BALANCE**

The test aircraft was weighed in the standard configuration (no fairings removed) after the installation of the test instrumentation. The weight and balance was conducted in a closed hangar using an electronic weighing kit. The basic weight of the aircraft with no fuel was 1528 pounds, and the center of gravity was 103.9 inches to the rear of the reference line which is 100 inches forward of the rotor center line.

Removal of the fairings did not significantly affect the weight and balance of the test aircraft. Total weight of the removed fairings was approximately 10 pounds.

## APPENDIX VII. PHOTOGRAPHS

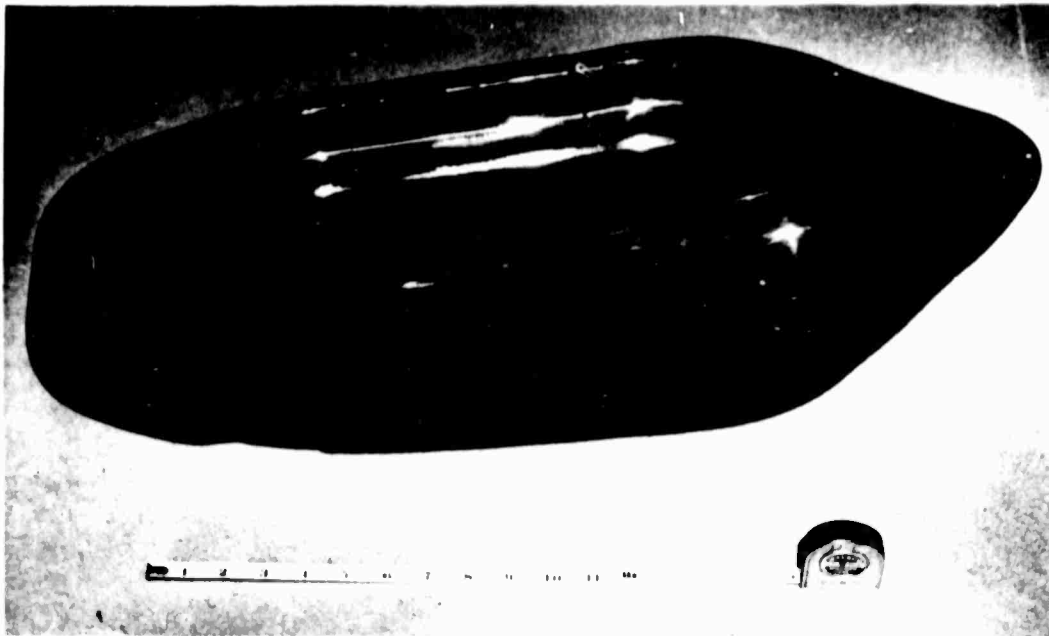


Photo 1. Lower Anti-collision Light Fairing.

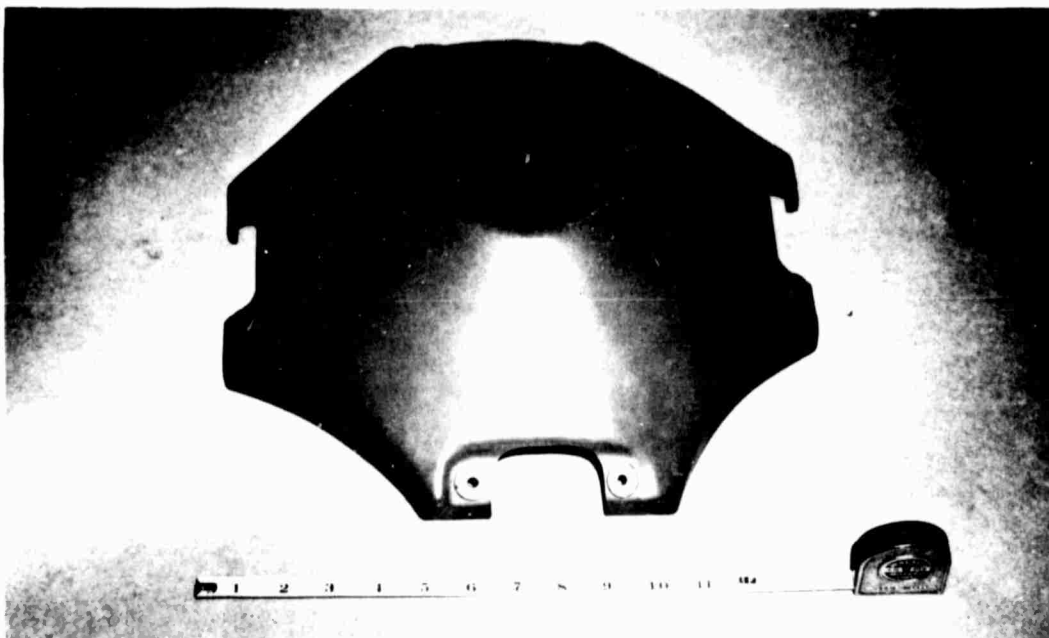


Photo 2. Main Rotor Hub Center Fairing.



Photo 3. Landing Gear Strut Fairings.

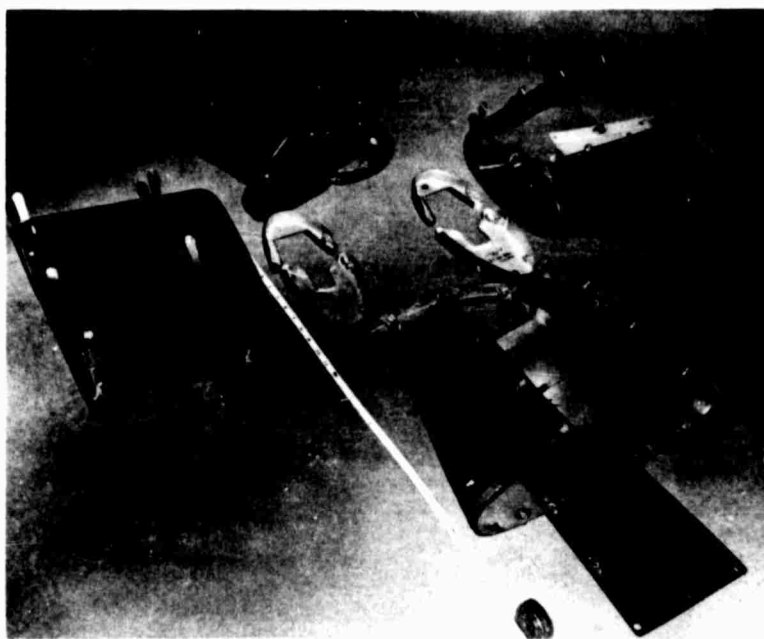


Photo 4. Main Rotor Blade Root End Fairings.

## DOCUMENT CONTROL DATA - R &amp; D

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13. ABSTRACT <p>Flight tests were conducted to determine the effects on performance and flying qualities with various fairings removed from the OH-6A helicopter. The fairings removed were the lower anticollision light cover, the main rotor blade root end fairings, the main rotor center hub fairing and the landing gear strut fairings. Individually removing the lower anticollision light cover, the main rotor blade root end fairings and the main rotor center hub fairing did not significantly affect the performance of the helicopter; however, removing the landing gear strut fairings resulted in a definite decrease in performance. The performance in the all fairings removed configuration was also significantly decreased. Stability and control tests were conducted in the all fairings removed configuration. Slight changes in control positions were evident but no major effects on flying qualities were observed. From a performance and flying qualities standpoint, it is feasible to operate the helicopter with these fairings removed. Although the performance changes are relatively small, allowances should be made in mission planning for all fairings removed and skid strut fairings removed configurations. If normal operations are to be conducted in these configurations, the data contained in this report should be included in TM 55-1520-214-10.</p>			

UNCLAS F I I U